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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/885,609	06/20/2001	Alfred W. Mak	5351/AMI-00-12	5337

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APPLIED MATERIALS, INC.  
2881 SCOTT BLVD. M/S 2061  
SANTA CLARA, CA 95050

EXAMINER

BERRY, RENEE R

ART UNIT	PAPER NUMBER
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2818

DATE MAILED: 03/14/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.  
09/885,609

Applicant(s)

Mak et al.

Examiner

Renee Berry

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-54 is/are pending in the application.
- 4a) Of the above, claim(s) 20-54 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-19 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claims \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some\* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\*See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). \_\_\_\_\_ 6) ☐ Other:

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## **DETAILED ACTION**

### ***Election/Restriction***

1. Newly submitted claim 26-54 are directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: Group I is claiming a method of making a barrier layer. The newly submitted claims are claiming a method of making a metal contact on a substrate surface.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claims 26-54 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

2. Applicant's election with traverse of Group I in Paper No. 8 is acknowledged. The traversal is on the ground(s) that the claims are linked by claim 20 and the language ...“means” for practicing the functions . This is not found persuasive because the instant apparatus can be used for a materially different process and therefore the inventions have a separate status in the art .

The requirement is still deemed proper and is therefore made FINAL.

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*Claim Rejections - 35 USC § 103*

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over US patent no. 5,942,799 to Danek et al. in view of US patent no. 6,495,449 to Nguyen.

In regard to claim 1, Danek teaches a method for forming a stacked barrier layer on a substrate disposed in a processing chamber, comprising serially exposing the substrate to first and second reactive gases to form an adhesion layer at column 5, lines 5-12 and 31-39.

In regard to claim 2, Danek teaches depositing a layer of copper adjacent to a barrier layer at column 4, lines 21-29.

In regard to claim 3, Danek teaches repeating serially exposing the substrate to first and second reactive gases to form an adhesion layer to a desired thickness before serially exposing the adhesion layer to third and fourth reactive gases column 5, lines 40-67 and column 6, lines 1-14.

In regard to claim 9, Danek teaches first and third gases each includes a refractory metal compound, with the refractory metal compound associated with the first reactive gas differing from the refractory metal compound associated with the third reactive gas at column 6, lines 2-25.

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In regard to claim 10, Danek teaches first reactive gas is selected from the group consisting essentially of TDMAT, TDEAT, and  $\text{TiCl}_4$  and the second reactive gas is selected from the group consisting essentially of  $\text{H}_2$ ,  $\text{B}_2\text{H}_6$ ,  $\text{SiH}_4$  and  $\text{NH}_3$  at column 6, lines 8-14.

In regard to claim 11, Danek teaches the third reactive gas is  $\text{WF}_6$  and the fourth reactive gas is selected from the group consisting essentially of  $\text{SiH}_4$ ,  $\text{B}_2\text{H}_6$  and  $\text{NH}_3$  at column 5, lines 33-34

In regard to claim 17, Danek teaches first reactive gas is selected from the group consisting essentially of TDMAT, TDEAT, and  $\text{TiCl}_4$  and the second reactive gas is selected from the group consisting essentially of  $\text{H}_2$ ,  $\text{B}_2\text{H}_6$ ,  $\text{SiH}_4$  and  $\text{NH}_3$ , the third reactive gas being  $\text{WF}_6$ , and the fourth reactive gas being selected from the group consisting essentially of  $\text{SiH}_4$ ,  $\text{B}_2\text{H}_6$  and  $\text{NH}_3$  at column 5, lines 33-35 and column 6, lines 6-25.

However, Danek does not teach all limitations 1, 4-8, 12-16, 18 and 19.

In regard to claim 1, Nguyen teaches serially exposing an adhesion layer to third and fourth reactive gases to form a barrier layer adjacent to an adhesion layer at column 5, lines 27-60 and column 6, lines 3-22

In regard to claim 4, Nguyen teaches repeating serially exposing the substrate to third and fourth reactive gases to form the barrier layer to a desired thickness after serially exposing the substrate to first and second reactive gases at column 5, lines 27-41.

In regard to claim 5, Nguyen teaches providing first and second processing chambers wherein serially exposing the substrate to first and second reactive gases further included serially

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exposing the substrate to first and second reactive gases while the substrate is disposed in the first processing chamber and serially exposing the adhesion layer to third and fourth reactive gases further includes serially exposing the adhesion layer to third and fourth reactive gases while the substrate is positioned in the second processing chamber at column 5, lines 27-41.

In regard to claim 6, Nguyen teaches providing first and second processing chambers wherein serially exposing the substrate to first and second reactive gases further includes serially exposing the substrate to first and second reactive gases while the substrate is disposed in the first processing chamber and serially exposing the adhesion layer to third and fourth reactive gases further includes serially exposing the adhesion layer to third and fourth reactive gases while the substrate is positioned in the first processing chamber and depositing a layer of copper adjacent to the barrier layer further includes depositing a copper layer adjacent to the barrier layer when the substrate is positioned in the second processing chamber at column 5, lines 27-41.

In regard to claim 7, Nguyen teaches providing first, second, and third processing chambers wherein serially exposing the substrate to first and second reactive gases further includes serially exposing the substrate to the first and second reactive gases while the substrate is disposed in the first processing chamber and serially exposing the adhesion layer to third and fourth reactive gases further includes serially exposing the adhesion layer to third and fourth reactive gases while the substrate is positioned in the first processing chamber and depositing a layer of copper adjacent to the barrier layer further includes depositing a copper layer adjacent to

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a barrier layer when the substrate is positioned in the third processing chamber at column 5, lines 27-60.

In regard to claim 8, Nguyen teaches serially exposing the substrate further includes introducing the second reactive gas into the processing chamber and further including purging the processing chamber of the second reactive gas before exposing adhesion layer to the third reactive gas at column 5, lines 27-41.

In regard to claim 12, Nguyen teaches serially exposing the substrate further includes serially introducing the first reactive gas and the second reactive gas into the processing chamber, and purging the processing chamber of the first reactive gas before introducing the second reactive gas by introducing a purge gas into the processing chamber after exposing the substrate to the first reactive gas and before exposing the substrate to the second reactive gas at column 5, lines 27-41.

In regard to claim 13, Nguyen teaches serially exposing the substrate further includes serially introducing the first reactive gas and the second reactive gas into processing chamber, and purging the processing chamber of the first reactive gas before introducing the second reactive gas by pumping the processing chamber clear of the first reactive gas before introducing the second reactive gas at column 5, lines 27-41.

In regard to claim 14, Nguyen teaches serially exposing the adhesion layer further includes serially introducing the third and fourth reactive gases into the processing chamber, and purging the processing chamber of the third reactive gas before introducing the fourth reactive gas by

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introducing a purge gas into the processing chamber after exposing the substrate to the third reactive gas and before exposing the substrate to the fourth reactive gas at column 5, lines 27-60.

In regard to claim 15, Nguyen teaches serially exposing the adhesion layer further includes serially introducing the third and fourth reactive gases into the processing chamber, and purging the processing chamber of the third reactive gas before introducing the fourth reactive gas by pumping the processing chamber clear of the third reactive gas before introducing the fourth reactive gas at column 5, lines 27-41.

In regard to claim 16, Nguyen teaches a method for forming a stacked barrier layer on a substrate disposed in a processing chamber by introducing the first reactive gas into the processing chamber and removing the first reactive gas from the processing chamber before introducing the second reactive gas; repeating serially exposing the substrate to first and second reactive gases to form an adhesion layer to a desired thickness; serially exposing an adhesion layer to third and fourth reactive gases to form a barrier layer adjacent to the adhesion layer by introducing the third reactive gas into the processing chamber and clearing the third reactive gas from the processing chamber before introducing the fourth reactive gas; repeating serially exposing the substrate to third and fourth reactive gases to form the barrier layer to an acceptable thickness; purging the processing chamber of the first and second reactive gases before introducing either of the third and fourth reactive gases; and depositing a layer of copper adjacent to the barrier layer at column 5, lines 27-60.



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In regard to claim 18, Nguyen teaches serially exposing the substrate to first and second reactive gases further includes removing the first reactive gas from the processing chamber before introducing the second reactive gas by introducing an inert gas into the processing chamber, and serially exposing the adhesion layer to third and fourth reactive gases further includes clearing the third reactive gas from the processing chamber before introducing the fourth reactive gas by introducing an expulsion gas into the processing chamber, and purging the processing chamber of the first and second reactive gases further includes purging and processing chamber by introducing a purge gas into the processing chamber at column 5, lines 27-60.

In regard to claim 19, Nguyen teaches serially exposing the substrate to first and second reactive gases further includes removing the first reactive gas from the processing chamber before introducing the second reactive gas by pumping the processing chamber clear of first reactive gas, and serially exposing the adhesion layer to third and fourth reactive gases further includes clearing the third reactive gas from the processing chamber by pumping the processing chamber clear of third reactive gas, and purging the processing chamber of the first and second reactive gases further includes pumping the processing chamber clear of all gases present therein at column 5, lines 27-60.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified Danek to include a method for forming a stacked barrier layer on a substrate disposed in a processing chamber by introducing the first reactive gas into the processing chamber and removing the first reactive gas from the processing chamber before

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introducing the second reactive gas; repeating serially exposing the substrate to first and second reactive gases to form an adhesion layer to a desired thickness; serially exposing an adhesion layer to third and fourth reactive gases to form a barrier layer adjacent to the adhesion layer by introducing the third reactive gas into the processing chamber and clearing the third reactive gas from the processing chamber before introducing the fourth reactive gas; repeating serially exposing the substrate to third and fourth reactive gases to form the barrier layer to an acceptable thickness; purging the processing chamber of the first and second reactive gases before introducing either of the third and fourth reactive gases; and depositing a layer of copper adjacent to the barrier layer, since such a modification would result in low resistivity and the ability to withstand volatile process environments, as described in column 1, lines 35-44 of Nguyen.

### ***Conclusion***

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. US patent no. 5,393,565 to Suzuki disclose a process for forming diffusion layers.

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to R. R. Berry whose telephone number is (703) 305-4544. The fax phone number for the organization where this application or proceeding is assigned is (703) 308-7724 or 7722.



RRB

March 5, 2003

**HOAI HO  
PRIMARY EXAMINER**